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ABSTRACT

The paper discusses the assessment of infant adaptive behavior and its relationship to the adaptive behavior of the mother, focusing on the discovery of disruption and asynchrony in early mother-infant interaction. The development of the earliest patterns of interaction between mother and infant is discussed, along with the relationship between developmental dysfunction and mother-infant interaction. A communication model for the early interaction between infant and mother is presented, emphasizing the importance of nonverbal communication and the rhythmic patterning of cues as a means by which each partner comes to have expectations for the behaviors of the other member of the dyad. Some major strategies for the longitudinal study of mother-infant interaction are described, and a procedure for recording mother-child communication codes is presented. The kinds of behaviors that are recorded between mother and infant are outlined, with an emphasis on the context in which the behavior is observed. A study of 20 individual mother-infant relationships is described, with the analyses of 30 complex interactional variables for the 20 normal Ss providing a frame of reference with which data from one individual mother-infant pair is compared. (DLS)

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Along with a growing demand for intervention at earlier and earlier ages, there is a growing need for identifying those infants who are in need of, and can be helped by, intervention measures. At the same time, there is increasing recognition of the difficulties of assessment at very early ages for the purpose of predicting developmental outcome. McCall, Hogarty, and Hurlburt, 1972) in a review of studies involving early assessment for prediction of later development, conclude that until 3 years of age prediction is unreliable. A review by Lewis (1973) draws a similar conclusion. More recently a report by McCall (1976) indicates some correspondence in relative test performance over the first two years, but he summarizes the problem: "The changes in relative position from one age to the next are more impressive than the similarities" (p. 100). It has generally been found that prediction is most reliable at the extreme low end of the continuum (Honzik. 1976), and that the extreme values are most responsible for the relatively high relationships reported in some studies. In extreme cases, of course, the biological damage to an infant from prenatal, perinatal, or early postnatal events is sufficiently severe that assessment for screening purposes is readily achieved with or without systematic procedures.

A major problem for assessment is posed by the infant without apparent anomaly who has been exposed to stressful circumstances in the prenatal

or perinatal period, such as anoxia or prolonged labor as isolated events or in combination with prematurity. As Parmelee, Kopp and Sigman (1976) point out, some infants with known risk status develop normally, whereas others have developmental difficulties at a later age. The challenge is to identify those infants who need continued surveillance and may at some future time be in need of clinical intervention.

A second major challenge for assessment is that of identifying infants who are born without any known previous stressors and appear to be fully normal very early in life but go on at a later age to have developmental dysfunction. The need is to identify these infants at as early an age as possible for purposes of intervention aimed at prevention or reduction of disability.

And the final challenge for developmental assessment is to be able to depict the developmental status of individual infants or children within the normal range. Reliable discriminations among normal infants is a prerequisite for a reliable indication of the nature and extent of deviance of any infant with abnormal characteristics.

The major obstacle to prediction of developmental outcome is posed by the developmental process itself, which is not unitary in nature nor linear over time. Furthermore, each individual infant has a unique developmental course (Wohlwill, 1973). An infant neither functions nor develops within a vacuum; and strategies for assessment which do not take this into account have proved to be futile. The most widely used assessment for newborns, the Brazelton Scale (Brazelton, 1973) very clearly reflects a recognition of this important point. Rather than subject the infant to a standardized sequence of prescribed stimuli, the scales are based on test items which are presented in accordance with the infant's state or arousal

level at any particular moment during the course of the test. The nature of the items include responsiveness to social as well as inanimate stimuli, all of which are conditions to which the typical infant must adapt during the course of naturally occurring events.

The recent emphasis by many researchers on mother-infant interaction reflects a recognition that an understanding of the developmental process, and assessment of the infant, must take into account an assessment of the environment in which the infant lives. The developmental process represents an ongoing integration between the characteristics of the infant and environmental experiences as they interact with the infant's characteristics. Expressed more explicitely, each individual infant has a unique organization of sensitivites and responsiveness to environmental events; and each family provides a unique set of environmental experiences for their infant. Any serious attempt at assessment for descriptive or predictive purposes must take into account the dynamic events that are involved in the developmental process for any individual infant.

Our approach to the assessment problem does not, at this time, include an effort to devise a practical, general-use and quickly applied testing instrument. Rather, we are taking a very different route to assessment by providing very intensive and empirical descriptions of infants in their natural environments. Our objectives are to identify the adaptive behaviors of each infant studied, the ways in which these adaptive behaviors fit with those of the mother, and to depict the short-term stability or changes in the patterning of their relationship-variables. Where judgments of an infant's coping capabilities can be made, these judgments constitute an assessment. Where

the interactive behaviors of mothers and infants are found to be demonstrably facilitative or interfering for the infant's developmental status, it is possible to assess, or evaluate, the relationship. The long-term predictive potential for such assessments is still another issue. Our immediate concern is to provide information on the nature of the earliest development of the infant and the mother-infant relationship. Reliable information on early functioning in the setting in which an infant is adapting should have significant implications for an understanding if not prediction of later development.

Parenthetically, it should be stated that an emphasis on the mother as the major figure for social interaction during the early weeks is not an expression of a lack of regard for the father's role. Parke (this volume) and others have provided impressive evidence for the significance of the father's interaction with the infant. Our studies begin at the time of the infant's birth; and for the population we have sampled, the primary caretaker at that time is typically the mother. During the course of our observations, when the father is present and interacting with the infant, he is the one who is observed. This is not a frequent occurrence, however; and not sufficiently frequent to provide useful data. However, since we have dedicated ourselves to taking the baby out of the vacuum for study, fathers are included whenever they "take over."

Development of the Earliest Patterns of Interaction

It seems reasonable to assume that the neonate's behavior and activity during its initial social encounters reveal adaptative behaviors derived from genetic and prenatal influences. These adaptive behaviors are modified during early development as a function of maturation processes and interaction with the mother or caregiver. The evolving interaction reflects a basic process which involves the infant's input into the mother-infant system and thus the infant's role in its own grwoth process. If this is so, then our ability to measure these patterns during the early days may allow us to begin to identify antecedents to subsequent development. Thus, to begin to understand the factors that influnce the development of an infant, it is necessary to describe the on-going process of mutual modification of mother and infant from the inception of that relationship.

Very few studies of mother-infant interaction have given attention to the development of the relationship from the earliest days after the infant's birth. Consequently, little is known about the arly stages of interaction or about how these early patterns may lead to more stable ones that become established over time. Our previous studies of mother-infant interaction have suggested that some very early interactive patterns may be responsible for later interactional patterns as well as for the behavior characteristics that develop in the child (Thoman, Turner, Leiderman and Barnett, 1970; Thoman Barnett and Leiderman, 1971; Thoman, Leiderman and Olson, 1972). These studies indicate that infants give cues during feeding from the first day of life and that mothers may vary markedly in their sensitivity to their infant's cues during feeding interaction. Specifically, during feeding interactions during the first three days of life, primiparious mothers were

found to show greater persistance in trying to get the infants to feed, greater inconsistency in terms of changing activities from feeding to non-feeding ones, and much greater stimulation of their infant during the course of the feeding. Other evidence (Brody, 1966) indicates that these early patterns of feeding interaction persist through the latter half of the first year. Likewise, characteristics found in mothers and their first and later-born infants are similar to those that have been reported in studies of mothers interacting with first and later born children at older ages. Mothers are generally more attentive to firstborns (Koch, 1954); mothers are more directive of the firstborn (Lasko, 1954; Stout, 1960); and they exert more pressure on the first child for achievement and responsibility (Davis, 1959; McArthur, 1956; Rosen, 1961; Sampson, 1962; Sutton-Smith, Roberts and Rosenberg, 1964). Mothers are also more inconsistent in their training of the firstborn (Hilton, 1968; Sears, Macoby and Levin, 1957); and they interfere more with the first child (Hilton, 1968). The prelude to these behaviors are indeed found in our observations of primiparous and multiparous mothers with their newborn infants.

In any mother-infant relationship, characteristics of both the mother and infant contribute to their ongoing process of mutual adaptation. This mutuality has long been a consideration for infants with developmental problems.

Developmental Dysfunction and Mother-Infant Interaction

Greenberg (1971) describes the interactional behavior of mothers and infants with atypical behaviors, and he reports "...a linking of atypical behavior, atypical development, disturbed and often withdrawn mothers, negligence and abuse in the case and treatment of babies..." (p. 416). This study began when the children were 2-1/2 years of age. However, if we are to understand etiology of developmental difficulties in infants, it is critical that we explore the relationships that may accentuate or diminish difficulties in the developmental process of infants much earlier than this age. For example, in research concerned with relating emotional deprivation in very young children and their failure to thrive, Leonard, Rhymes and Solnit (1966) found marked inadequacy in the mother-infant relationships. The mothers expressed feelings of inadequacy and they appeared incompetent in terms of dealing with the feelings and other activities of their infants. These women were, in fact, failing to thrive in their development as mothers. The authors observed that developmental characteristics of the infants may have also contributed to the maternal-child difficulties. "Thus, each infant and mother contributed reciprocally to the other's failure to thrive as well as the faulty relationships between them" (p. 610).

The nature of interaction failure is further illustrated in a study of colicky infants. Carey (1968) found that mothers of infants who cried excessively provided a great deal of stimulation for their infants, but

their efforts failed to comfort the infants. The primary characteristic of the maternal caretaking activities was its inconsistency, which apparently derived from uncertainty about the role of the mother. This uncertainty was clearly expressed prior to the onset of excessive crying in their infants. Even though these mothers stimulated their infants, their stimulation was in no way designed to match the needs of the infant or infants. Either a) the infants did not indicate their needs by the behavior exhibited, or b) the mothers failed to perceive the infants' behaviors as cues for their own caretaking behaviors. Disruption of this process by any of several means -- such as premature birth, unresponsive or disorganized responses of the infant, or inadequate mothering -- should serve to exaggerate the infant's difficulties in the course of development. Our research and that of others has indicated that the mutual adaptation -- or maladaptation -- of mother and infant begins from the time of birth.

These considerations suggest the general rule that the earliest organization of the mother-infant system occurs as a function of the capacities of both the mother and her infant; the infant's capabilities for indicating its status, signalling its needs and responding to maternal interventions; and the mother's ability to perceive cues provided by her infant and to respond appropriately to these cues.

A Communication Model for the Early Interaction

The major assumption for our model of mother and infant interaction is that it constitutes a communication system from the time of birth. It is the nature of this communication network that must be explored. Our position is that during very early mother-infant interactions, linguistic models are not yet applicable to an attempt to understand the nature of mother and infant communication. The earliest communication has characteristics which are

unique to this stage of development, requiring special explanatory principles rather than ones derived from functioning at a later age. The newborn infant is biologically designed for survival in a social environment and is thus a "born communicator." The cue-giving capabilities of infants have long been of interest (e.g., Ainsworth, 1967; Call, 1964; Robson, 1967). But the nature of the earliest communication has not been considered in terms of how it may differ from the organization of cue-exchanges which occur sequentially as in verbal exchanges at a later age.

Primarily, the earliest communication is essentially affective in nature. That is, "information" in the traditional sense is not intentionally being transmitted, whether communication takes the form of vocalization, of gesture, or of contact body movements. The sensory systems of the human infant are remarkably well developed; and the communication process consists of multimodal sensory stimuli provided by the holding, moving, talking, looking, and other forms of intenventions given simultaneously by the mother and baby during any interaction. The simultaneity of cue-giving behaviors is an important quality of these exchanges, with variations in temporal overlap -- a "feathering" of behavioral events (to use a descriptive term from Golani, 1978).

The mutual cue-exchange of mother and infant has been described as a dance by Gunther (1961), and others. That is, it is possible for a mother and infant to achieve a rhythm of interaction in which each can lead or follow or anticipate the actions of the other and thereby exhibit simultaneous communicative behaviors as is the case with two partners dancing. Stern (1977) very eloquently describes the simultaneity of mutual behviors of mother and infant, and he has examined these patterns in great detail both in vocal (Stern and Gibbon, 1978) and visual (Stern, 1974) modalities.

A variety of research techniques may be needed to thread out the related patterns and their changes over age. A number of investigators have been engaged in fruitful research beginnings in this area (Brown, Bakeman, Snyder, Frederickson, Morgan and Helper, 1975; Dunn and Richards, 1977; Berwith, Cohn, Kopp, Parmelee and Marcy, 1976).

A very molecular approach has been taken by Tronick, Adamson, Wise, Als and Brazelton (1975), Condon and Sander (1974), and Stern (1971, 1974a, 1974b). Using time-lapse photography and frame-by-frame analyses of films, they have demonstrated temporal relations between the behaviors of mothers and infants. In these analyses, behaviors are found to occur either simultaneously (i.e., in the same time-frame) or so close together sequentially that it is impossible to view the behaviors in an initiator-responder framework. Their research emphasizes again the importance of observing the behaviors of both members of the system simultaneously if the behavior of either member of the pair is to make any sense. This evidence for a much more complicated communication network between mother and infant than has previously been assumed opens new vistas in the area of empirical study of the infant as a social and feeling being.

Almost certainly the principles involved in the early affective communication between mother and infant differ from those involved in later linguistic communication. We are not the first to maintain that the principles applied to the study of language are not applicable to early communication. Chomsky (1967) has taken a very strong stand on this issue, contending that the non-linguistic communication of animals and infants has no continuity with the nature of language. Without limiting ourselves to Chomsky's formal linguistic framework, we should heed his warning that very different principles may apply

to linguistic and pre-linguistic communication. This may continue to be the case at a later age when non-linguistic communication continues to develop concurrently with the acquisition of specialized, conventional verbal forms of communication but according to different principles.

The importance of rhythms is another facet of non-verbal communication that may relate both to the simultaneous exchange and the affective quality of early interaction. Rhythms may be very molecular moment to moment ones or they may be of longer-durations -- minutes or hours (Ashton, 1976; Sander, Stechler, Burns and Lee, 1978: Tronick and Brazelton, 1978; Brazelton, 1974, 1977; Stern, 1977; Tronick, Adamson, Wise, Als and Brazelton, 1975). These are potentially derived in part from the infants own endogenous rhythms. As the researchers cited, and others, have pointed out one of the major tasks of mother and infant is to synchronize their separate rhythms. When this occurs, one can say very subjectively that the nature of the interaction on a moment-to-moment basis or over longer time spans is truly like a dance. Progress has been made by each of these researchers toward depicting the qualities of the "dance."

The importance of nonverbal communication and the rhythmic patterning of cues has been emphasized as a means by which each partner comes to have expectations for the behaviors of the other member of the dyad.

Major Strategies for the Longitudinal Study of Mother-Infant Interaction

The very general objectives of our research with infants and their mothers are: (1) to identify individual characteristics of infants from the time of birth (2) to describe the nature of the mother-infant interaction in terms that depict their capacity for synchrony, and (3) to identify

the effects of the mother-infant interaction on the developing behaviors of the infant. These objectives are congruent with our purposes already indicated, namely, to provide some understanding of the developmental processes during the infant's earliest weeks of life, both with respect to the infant's own behavioral organization and with respect to the social network the infant interacts with; and to identify individual patterns of developing mother-infant relationships for predictive purposes.

With these objectives in mind, the research is guided by simple but relevant strategies:

First, as indicated in the objectives listed above, developmental study of the infant and of the mother-infant relationship is begun at its inception, that is, within 24 hours after the infant's birth. Only by observing the infant separately and with the mother from the time of birth will it be possible to identify the initial characteristics of the infant and his contribution to the mother-infant relationship. Also, only with such early observations, followed by successive observations repeated over relatively short time intervals, will it be possible to infer the relationship of the infant's adaptive capabilities and characteristics of the mother-infant interaction.

Second, the mother and infant are observed under circumstances which are as natural as possible. That is, they are observed in the hospital immediately after the infant's birth, and they are observed in the home during their usual routine, without any interventions or contrived situations. In this way, and to the extent that the effect of the presence of an observer is minimized, it should be possible to describe real mothers and infants interacting in their real world. Infants are observed

alone when they are left alone by the mother, and the mother and infant are both observed when they are together.

Finally, our studies of mothers and infants involve intensive observations, in terms of total duration of observation, frequency of behavior recording, and number of behaviors recorded. This aspect of our research is the result of more than a decade spent in developing observational procedures and recording techniques. We have found that a whole day's observation (7 hours) enables us to record the mother-infant interaction in the variety of circumstances under which it typically occurs -- e.g., feedings, caretaking activities, baby naps, periods of intermittent social interaction, and even periods when the mother may be focused on housework despite auditory cues from the infant. Successive weekly observations of 7 hours duration provides measures that reliably describe individual infants and mother-infant behaviors (Thoman, Becker and Freese, 1978; Thoman, Acebo, Dreyer, Becker and Freese. 1978)

Code Recording Behaviors in Natural-Living Circumstances

An important aspect of the intensity of the observation is the large number of behaviors that are recorded. The code-recording procedure is based on a number of principles which enable us to record a great deal of information with minimal time and motion. The nature of the code is very much like a language, with nouns, action words, and modifiers. Intensive training for weeks or months is required to use this code-recording system reliably. In fact, we believe that we have fulfilled the request made by a noted pediatrician, Dr. Carlton Gajdusek (Developmental modification of human form and function: the problem of coding in the study of patterning in infancy of nervous syster

function, 1968). He calls for a notational system for behaviors such as Laban dance notation served for body movements, a "cipher language," as a taxonomic sorting of "...observations on what stimulation a child receives" from the environment and what response to it he makes -- e.g., his environmental experiences and his behavioral response...." (p. 13), and he concludes most enthusiastically: "if pediatric research gives us a new notation and representation for 'those first affections' of perception, it will have contributed to more than the remedy of the ailments of man, but, as the arts, to the joys and means of his existence!" (p. 14). This dramatic statement is a rare bit of reassurance of the importance we have placed on the ability to record as many of the behaviors of the mother and infant in their natural circumstance as possible.

While there are some behaviors which infants emit that may be considered universal as cues within the mother-infant communication network -- crying or smiling, for instance -- it is not reasonable to expect to understand the complexities of multi-modal communication by focusing on these cues alone. The same holds for maternal behaviors. The vocabulary of behaviors that are important in each relationship may differ. It is necessary, therefore, to record as many cue-behaviors as possible in order to identify in each individual relationship those that may serve most potently. An example of this principle is given in our report (Thoman, Becker and Freese, 1978) of one mother-infant relationship in which the baby's open-eyed REM was responded to as wakefulness. On numerous occasions, the baby was fed immediately following an episode of open-eyed REM; and accordingly, the feedings were very brief as the baby was unresponsive (obviously asleep) on these occasions. In fact, most mothers seem to unaware of the occurrence

of open-eyed REMs. In the case of this one mother-infant pair, the dynamics of their interaction surrounding the feeding would remain a mystery without a record of this specific behavior.

Given the subtleties of the early non-linguistic communication, it is necessary to record a large number of behavioral actions any -- or many -- of which may serve as cues by each member of the dyad for the other. Only extensive data from each dyad can reveal which behavioral cues are relevant and which are not for that particular pair. At the same time, extensive data can reveal which behavioral cues may be common to all pairs of mothers and infants, to sub-groups of mothers and infants, or occur uniquely within a single mother-infant pair.

Several factors make it possible to reliably record a very large number of mother-and-infant behaviors. First, many of the coded behaviors occur only in limited contexts. For example, behaviors such as Suck Stimulation, Not-Sucking, and Not-Attached (see Table 1) occur only when the infant is feeding or has been given a pacifier. Secondly, the detail with which certain variables are recorded varies within the observation. For instance, distinctions among the sleep states are made only when the infant is alone in the crib. Also, the variables include a number of totally inclusive and mutually exclusive categories of behavior which require code-recording only when a change occurs within the category. For example, an infant's position is coded as Prone, Up, at Shoulder, or Supine. Once a position has been recorded, it is not re-coded until the position changes. Finally, economy in recording is aided by the use of standard inferences which eliminate the actual marking of some variables. For instances, if the mother carries the infant, this implies that the infant is being moved, and consequently the Move category is not marked.

Behaviors Recorded

Very generally the kinds of behaviors we record in the home during the early weeks are designed to give information about the infant's behavioral states throughout any observation; including sleep states, state-related behaviors, and respiration during periods of time in the crib; maternal behaviors that describe her location with respect to the infant, the position in which she holds or places the infant, stimulation given to the infant including tactile, movement, vocal, gestural, and visual attention; and the nature of her activities during periods of caretaking interaction including feeding, changing, or bathing the baby.

The infant's state provides an ongoing developmental characteristic for assessing the relationship between mother-infant interaction and the infant's development. State is an ubiquitous expression by the infant at all times, at all ages, although the quality of expression and organization of state parameters change with age. Individual differences in state organization (Thoman, Korner and Kraemer, 1976; Thoman, 1975a) reflect both environmental and maturational influences (Thoman and Becker, 1978). "...the differentiation of behavioral state becomes the central developmental characteristic of the newborn." (Sameroff, 1972, p. 210).

It should be noted that all behaviors are regarded as characteristics of the mother-infant relationship, even though it is necessary to record some as mother behaviors and some as infant behaviors. The activities of each member of the dyad are considered to be a function of the total interactive system: Even when the infant is asleep, as indicated in the description given earlier, there may be an exchange between the partners. And characteristics of the sleep states may reflect the immediately previous interaction during the infant's wake period, as well as the ongoing rhythmicity attained in the relationship.

Behavior and context.

This view of relationship variables has major implication for using the behavioral data. A variable may consist of a single behavior or any combination of behaviors, for example, mother behaviors such as pat, or pat-and-caress, or pat-or-caress may each be considered as variables. Either baby sucking, or sucking-while-alert may be considered as a variable. Combinations of mother and baby behaviors may also be considered as variables for analysis. For example, vis-à-vis involves both members of the dyad, the mother may be holding the baby and providing any of a variety of forms of stimulation, while the baby is in any of the behavioral states that are recorded. Thus, any cluster of these co-occurring mother and baby behaviors may be considered in combination as a variable to be assessed for its frequency, duration (number of episodes) or variability in duration. Defining and analyzing data from a wide variety of combination variables is the unique potential that is derived from having recorded a large number of behaviors throughout an extended period of time.

Another way of viewing the behaviors as variables is to consider the context in which they occur. For example, mother talking while the baby is crying is very different from mother talking while the baby is quietly alert. Thus, mother talking can be considered with either crying or alert as the context, or backgroundvariable. By the same token, the same variable can serve as the context for different behaviors on the part of either member of the dyad. For example, while the mother is holding the baby, the baby can neither be crying or can be in a quiet alert state. It can be seen that any combination of behaviors of one or both members of the dyad can be measures within the context of a wide variety of other behavioral

combination variables. Again, this potential is available because of the large number of behaviors of both mother and infant that are recorded.

It may be well to make a more explicit distinction between assessing combinations of variables and assessing one variable within the context of another one, i.e., using the second variable as the background variable. Figure 1 shows a bar graph representing a 7-hour observation. During 27 percent of this particular observation the mother was holding the baby. During 15 percent of the observation the baby was alert, and the baby was alert 42 percent of the time the mother was holding the baby. There were also alert periods when the mother was not holding the baby. If epochs of Baby Alert and Mother Holding are counted they constitute 11 percent of the observation; however, if Mother Holding is the background variable, then baby alert is 42 percent of Mother Holding time. Thus, whether the total observation or a portion of the observation is identified as the background variable, the percentage measure will differ. This distinction is a very important one for analyzing the mother-infant process, and it will become more clear as the data are described in the sections that follow.

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Insert Figure 1 about here

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In the remaining section of this paper, additional details of our procedures will be described, data from the total group of 20 subjects will be summarized, and comparison data for one individual mother-infant pair will be presented. One purpose is to demonstrate that the patterning of relationship behaviors for individual mother and infant pairs can be reliably described during the early weeks of life. A second purpose is to demonstrate

that the quality of an interaction can be described quantitatively by comparing the single subject with the overall patterning shown by a comparable group of subjects.

A Study of Twenty Individual Mother-Infant Relationships

Procedures

Some of the procedures for this study have already been referred to, and a more complete description of the methodology has been given elsewhere (Thoman, Becker and Freese, 1978; Thoman, Acebo, Dreyer, Becker and Freese, 1978). However, a few additional details may give a more coherent picture of how the data were obtained.

The subjects were twenty primiparous mothers enrolled in the project during their last trimester of pregnancy, and their infants born at full-term without perinatal or early postnatal problems.

Prenatal assessments of mothers were obtained from interview and questionnaires. Mothers and infants were observed in the hospital during the early postpartum period (Freese, 1975), during two feedings while they were together, and during one interfeeding period while the infant was in a crib in an observation room.

The first home observation was made when the infant was 8-14 days of age, with subsequent home observations made at approximately weekly intervals. Each observation consisted of a continuous 7-hour period. Two observers participated in the observation, each recording for 3-1/2 hours. The changing of observers in the middle of the observation was accomplished without interruption of either the observational procedures or ongoing household activities.

During the observation period the observer avoided interaction with anyone in the household. She selected locations which permitted a clear view of the infant's face but where she was as unobtrusive as possible in the household setting. Wherever the infant was moved the observer followed. During long sleep periods when the infant was in the crib, the observer remained with the infant and recorded sleep patterns. It was made clear beforehand, however, that though

the observer remained with the baby she in no way acted as a "baby-sitter" in the mother's absence.

Throughout each 7-hour observation the occurrence of any of 75 mother or infant behaviors (presented in Table 1) were code-recorded every 10 seconds. A small electronic timing device provided the observer with a signal through an ear microphone every 10 seconds. At each signal the necessary codes were recorded, with no formal pause in the observational process. In this way, nearly continuous recording of the occurrence at each variable was possible.

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Insert Table 1 about here

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Reliabilities among the three observers who carried out these observations were calculated for each variable using the following formula:

$$\frac{2\ (\text{number of agreements})}{\text{number of occurrences recorded by both observers}}$$

The interrater reliabilities among the three observers for variables to be analyzed for this report ranged from .75 to .99.

The data to be described came from the four observations on weeks 2-5. For the 20 mother-infant pairs, more than 200,000 ten-second epochs were recorded over the four home observations, with presence-absence information on 75 behaviors during each epoch.

Variables analyzed for mother-infant pairs on weeks 2, 3, 4, and 5.

From the list of recorded behaviors presented in Table 1, combinations of mother and/or baby behaviorswere selected as relationship variables most relevant for desc.ibing the pair of special interest. Variables were defined from behaviors occurring concurrently within each epoch. Some variable combinations are obvious from their labels; the components of others need to be specified, including the following:

Total Observation. The number of epochs in any home observation.

Caretaking. Themother-infant pair is engaged in one of the following activities: feed, change, or bathe.

Social Interaction. All of the following are occurring: (1) the infant is in the Awake state; (2) the mother is holding or carrying the baby; and (3) the mother is not engaged in a caretaking activity.

Mother Looking and Baby Awake. While the baby is awake, themother is looking at the baby's face and holding him/her in the en-face position, but the infant is not looking at the mother's face.

Stimulating. The mother is engaged in any of the following maternal stimulation variables: pat, caress, move, or rock.

The remainder of the variables analyzed ere either single variables or combination of variables taken directly from Table 1, such as Hold or Carry, or Fuss or Cry, or Drowse or Daze, or Change or Bathe.

Stability of Mother-Infant Behaviors During the Early Weeks

Absolute frequency of occurrence is usually not the appropriate measure for assessing these relationship variables. First, the total number of epochs in an observation was never exactly equivalent to the 2520 that make up a 7-hour period ($\bar{X}$ = 2495; s.d. = 110); and second, as already indicated, many of the variables constitute a portion of some context behavior which was itself a component of the total observation. Figure 1 illustrates the definitional description of some of the variables: the baby's alertness can be measured as a percent of the total observation, written as Baby Alert (Total); it can be measured in terms of the percent of time the baby was being held by the mother, written as Baby Alert (Mother Holding); or it can be measured when the mother is not holding the baby, Baby Alert (Mother Not Holding). Although each variable assesses the baby's alertness, they may or may not be highly correlated, and each may be very important for depicting the characteristics of individual mother and infant relationships.

Table 2 presents summary values for the measures of concern for this report. The group means are based on means for each of the 20 individuals over the four weekly observations. The four weekly observations permitted assessment of individual differences among mother-infant pairs for each of these measures of the interaction. An analysis of variance for repeated measures was used to assess individual differences as well as changes over weeks, and sex effects. There were no significant sex effects for any of these variables. For two variables, there were significant monotonic trends

over weeks: Vis-à-vis (Total) and Vis-à-vis (Mother Looking and Baby Awake). The latter variable refers to those epochs in which the mother was looking at the baby while maintaining the en-face position -- while the baby was awake but not returning the mother's visual gaze. The mean rate of each of these variables increased over the four weeks of observation. There were significant individual differences for all but two of the interactive variables: Drowse or Daze (Total) and the Number of Episodes of Sleep lasting 5 minutes or longer. The results of these analyses provide evidence for significant stability across weeks for most of the variables listed in Table 2.

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Insert Table 2 about here

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Table 2 also presents the total-test reliability (reliability over observations) for each variable based on the formula $r_{tt} = (1 - 1/F)$ and the standard error of measurement based on the formula $SEM_{eas} = s.d. \left(1 - r_{tt}\right)$ The very high lower-bounds reliability values shown in Table 2 indicate that the mean scores across the four weekly observations reliably measure behaviors of each individual mother-infant pair over this period of time. Each of these reliable measures are, therefore, potential predictors of later behavior.

Patterning of Behaviors in the Mother-Infant System for the Group of 20 Infants.

It can be seen from Table 2 that babies during the first 5 weeks of life spend about a third of the day awake: a little less than half of the wakeful time is spent in alertness, and slightly less of the wakeful time is spent in a drowse or daze. These normal babies fussed or cried only about 4% of the 7-hour period, that is, averaging 102 epochs or approximately 17 minutes per day. During the epochs when the babies were fussing or crying the mothers were looking at them much of the time (60.9% of Fuss or Cry epochs); they were talking to the infants 41.2% and stimulating them 35.4% of the fuss-and-cry time. The distribution of talking and non-talking is very similar when social interaction is a context variable: Talking (Social Interaction) = 46.1%. However stimulation is distributed very differently during social interaction and when the baby is crying. Stimulation (Social Interaction) = 81.2%; Stimulation (Fuss or Cry) = 58.8%. Stimulation includes patting, caressing, moving or rocking the baby. It is somewhat surprising that mothers generally do more of these kinds of stimulation during social interaction periods -- which may also include epochs of fussing and crying -- than they do during fussing or crying as the context variable. This may in part be due to the fact that fussing or crying occurs more during caretaking activities (27.5% of Change or Bathe) and relatively little during social interaction (9.9%).

Characteristics of the infants' sleep are also depicted in Table 2. They typically had less than 3 naps during the day (sleeping periods longer than 5 minutes). The sleep was divided 33% in Quiet Sleep and 67% in Active Sleep. Quiet Sleep$_a$ composed most of the infants' Quiet Sleep (80.0%) time. This variable refers to Quiet Sleep periods when the respiratory pattern is judged to be highly regular from breath-to-breath (Thoman, 1975a). During Quiet Sleep$_a$, respiration shows some irregularity and may include episodes of brief apnea

It can also be seen from Table 2 that mothers spend approximately 14% of the 7-hour day in caretaking activities and a little less than that proportion in social interaction. Mothers spend 26.9% of the day holding their babies; and 43.2% of this time is used for caretaking purposes. The remainder of holding time is used for social interaction or for holding the baby while the baby is asleep. It should be noted that the definition for Social Interaction requires that the baby be awake. Overall, the mothers and babies were engaged in social interaction only 29.5% of the baby's waking time.

Table 2 indicates those activities of mothers that are associated with the baby's state organization. It can be seen that the babies were more likely to be alert when the mother was caretaking -- changing or bathing -- than during social interaction or feeding. During feeding the babies were more likely to be in a drowsy state.

And finally, Table 2 presents the total amount of affectionate stimulation given by mothers throughout the day. These values are relatively low. Caressing 8.4% and patting the baby 3.5% of the 7-hour day. During many of these epochs the two are occurring simultaneously, so that the two percentages are not additive. Vis-à-vis (Total) is also relatively low: 2.6% but during a much greater period of time, 12.4%, the mothers make themselves available for vis-à-vis. Both of these latter variables are ones that show a significant increase over weeks, as already indicated.

These data give a picture of the distribution of mother and infant behaviors over their 7-hour day. Such a detailed description of mother-and-infant behaviors has not been presented before.

The Relating Process in One Mother-Infant Pair

Mother-infant pair M was selected for detailed description because of some specific characteristics of the infant that appeared to the observers to be a real impediment for the mother-infant relating process. The baby was an extreme example of the non-cuddly type described by Schaffer and Emerson (1964). When the baby was held, he showed obvious signs of distress; his state was more generally that of a drowse or daze rather than alertness, or even fussing or crying. One would not expect these behaviors to be part of an interactive system that could develop optimally. A baby's visual responsiveness to the mother is a most rewarding behavior for her ministrations and attention, and these rewards were clearly lacking from this baby. We have described these aspects of the baby's behaviors in previous reports (Thoman, Acebo, Dreyer, Becker and Freese, 1978; Thoman, 1975b). However, the present report focuses on the details of the mother-infant interaction from data analyses that illustrate our pattern approach to assessing an individual baby and an individual mother-infant relationship.

Interaction Profiles for Mother-Infant Pair M

The mean value over weeks for mother-infant pair M on each of the variables assessed are presented in Table 2 so that the percentage levels can be compared with those for the total group of 20 babies. Since this pair was separated from the group for special consideration post hoc, they were included in the total group analyses.

In order to provide an overview of the comparisons of mother-infant pair M with the total group, a profile method of presentation is used. The strategy of comparing an individual with a normative group is commonly used in clinical assessment. With the group mean as a baseline, each of the measures for mother-infant M in Table 2 were transformed to z-scores and plotted to indicate deviations from the mean of the group. The resulting series of profiles are presented in Figures 2, 3, 4, 5, and 6. Because each measure had a very high reliability score, it is appropriate to use the data in this fashion to depict the variations of an individual subject. The standard error of measurement is also included, however, to emphasize the extreme deviations of some of the measures for pair M. This procedure was designed to highlight the characteristics of relationship M.

Figure 2 presents a profile of Baby M's behavioral state organization. From this figure, it can be seen that overall Baby M was awake and alert more than most babies and not very fussy. This much of the description is not consistent with that given earlier in our explanation for choosing this baby as a subject -- in which the amount of drowse and fussing by the baby was emphasized. However, it can be seen that baby M did exhibit, throughout the observation, a greater amount of drowse and daze. Subsequent analyses will further clarify this apparent paradox.

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Insert Figure 2 about here

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Figure 2 also gives a clue to the baby's sleep organization. Despite the fact that Baby M had less sleep time (as indicated by the greater wakefulness), the number of eposodes of sleep were greater than the average for the group. A most dramatic aspect of this baby's sleep was the very high percent of quiet sleep. The implications of this characteristic will be discussed later. The final characteristics, quiet sleep$_A$ (Quiet Sleep), is a measure of regularity of respiration during quiet sleep. Baby M was relatively high on this measure, indicating fewer periods of erratic respiration during quiet sleep. The characteristics presented in Figure 2 are mixed ones with respect to any assessment of the baby's behavioral state organization: although erratic in his sleep-wakefulness, his sleep states showed a high degree of inhibitory control, generally considered to indicate a higher maturational level.

If we now focus on the mother's side of the interaction, Figure 3 presents characteristics of the relationship in terms of how the mother distributed her caretaking and non-caretaking time. It can be seen from Figure 3 that Mother M spent relatively little time in caretaking activities, that is changing or bathing or feeding, in comparison to other mothers. A most notable characteristic is that despite the fact that she held or carried the baby somewhat more than other mothers a much lower proportion of the time she held the baby was for caretaking purposes. Mother M held her baby primarily for non-caretaking activities. This characteristic is also reflected in the portion of the profile indicating that she and the baby spent a very high percent of their time in social interaction -- whether this was measured as a percent of the total observation or as a percent of the infant's waking time. This profile clearly indicates a mother who is giving a great deal of attention to her baby not required for changing, feeding or bathing him.

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Insert Figure 3 about here

The next figure, Figure 4, relates Baby M's states to the mother's activities. The first notable characteristic of the baby in this regard is that he was alert less than the other babies when he was with the mother, during social interaction and during feeding. This is quite inconsistent with the high degree of alertness depicted in Figure 2. However, it must be noted that the apparent discrepancy is accounted for by the very great amount of alertness shown by Baby M when he was being changed or bathed and when he was alone in the crib. His differential alertness under these different circumstances has been described in detail in previous reports (Thoman, 1975c; Thoman, Acebo, Dreyer, Becker and Freese, 1978). Rather than being alert, Baby M was either fussing or crying or he was drowsy during social interaction; during feeding he was in a drowsy state a great deal.

(Insert Figure 4 about here)

Baby M's state patterns become comprehensible when they are separated into circumstances when the mother is holding the baby and those when she is not. For instance, during social interaction and during feeding the mother is holding the baby. Whereas during changing or bathing the mother typically is not holding the baby. Note that during change or bathe Baby M was highly alert and fussed and cried very little. The pattern of measures suggests a synchrony between the mother and baby when the baby was not being held.

Figure 5 returns to the mother's side of the interaction, with a description of her stimulation of the baby. In general, Mother M was high on all forms of stimulation and especially high when the baby was fussing and crying. In view of the baby's fussiness especially during social interaction, it appears possible that her stimulation was excessive or inappropriate. However, the patterning of the baby's states just described suggests that her stimulation when the baby was irritible was not inappropriate, though it was

apparently ineffective in soothing him. The baby's general aversion to being held is most apparent in the data.

(Insert Figure 5 about here)

The stimulation variables in Figure 6 are presented separately because they are worthy of special emphasis. It can be seen that Mother M patted and caressed her baby a great deal throughout the day, when compared with the group of mothers. Her affectionate stimulation was consistent with the generally high level of stimulation and attention she gave her baby. Their mutual visual attention provides a somewhat different picture. The level of vis-à-vis between Mother and Baby M is close to that of the total group. However, the mother was very persistent in her efforts to achieve vis-à-vis with the baby; as indicated by vis-à-vis (Mother Looking and Baby Awake). Although, by definition, the baby was awake during these periods of being placed in the en-face position, he did not return her gaze. This characteristic of the interaction is again consistent with the baby's aversion to being held, since at this age vis-à-vis almost invariably occurs when the mother is holding the baby.

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Insert Figure 6 about here

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DISCUSSION

The analyses of 30 complex interactional variables for the 20 subjects gives a rather detailed description of how mothers and babies spend their day togehter during the first 5 weeks of life. The variables analyzed include combinations of behaviors of mothers and babies occurring concurrently; they also include behaviors of both members of the pair under a variety of circumstances. Naturalistic studies of mothers and infants have typically not involved such detailed information in such a short age span. In fact, because of the brief age span covered by these observations there was not a developmental change over weeks on most of the measures. Thus, stability over weeks was a major finding with respect to mother-infant relationship measures over this time period.

The data from the total group of normal subjects provided a background distribution as a frame of reference for portraying the relating process of one mother-infant pair. Observations over four successive weeks permitted assessment of reliability of the measures; and the very high reliability, along with the general finding of stability over weeks, permit the conclusion that these measures could be averaged over weeks to provide a reliable description of individual infants or mother-infant pairs. It was with the use of such data that we described the mother and infant of special interest for this report.

The use of profiles constitutes a non-linear approach to assessing a developing infant. A look at the profiles taken as a whole makes it clear that no single variable nor even the long list of variables considered separately could provide a meaningful portrait of this mother and infant pair.

As the picture of the subject described in this report indicates, deviance on any single measure is not necessarily "all bad." In fact, the unusual behaviors of the baby in this study were possibly counteracted by unusual behaviors on the part of the mother, namely the very great amount of attention and gentle affectionate stimulation she gave the baby. This interpretation is supported by followup assessment and observations. At one year the baby's mental developmental quotient, assessed by the Bayley Scales, was 112. Even more relevant is evidence for his social-emotional development. During three weekly home observations at one year, this baby cried less than any other in the group of 10 observed at that age. Although the mother and baby interacted at about the same overall level as the other mother-baby pairs, their interaction clearly reflected an adaptation to the baby's early avoidance response to body contact. Their actual body-to-body contact was extremely low; physical contact consisted primarily of the baby's body being in contact with the mother's legs on occasions that the baby approached her. Other forms of interaction replaced intimate physical contact of this pair, including looking, talking, and touching. While the mother did not differ from the total group in the percent of time she was available for interaction with the baby, the baby was very low with respect to crying as an attention-seeking behaviors when no interaction was ongoing. In numerous ways, the mother seemed to be allowing the baby to pace the interaction. Thus, all indications from our observations suggest the development of a highly adequate and synchronous relationship, one that should continue to be facilitative of the baby's development.

The data bank accumulated from the observations of the twenty subjects through the first year offers the possibility for profiles of each individual pair, using the same variables, or, additional ones. In each case, the objective would be to identify the most salient characteristics of the particular relating pair. Commonalities among sub-groups of infants with similar profiles should give far greater information on developing infants and mother-infant relationships than analyses derived from summary statistics for the group as a whole.

A current extension of this project is relevant to the present volume, namely, the addition of infants born with risk status. Infants born prematurely or small-for-dates are now being included. These subjects will offer the opportunity to assess differences in the early relating process among mother and infant pairs with a wider range of expected outcomes. Individual analyses of data from each of these infants is of special importance, as their patterns of deviation from the normal group should give clues as to whether there are disruptions in their early developmental course. Neither the mothers nor the babies to be included in our project will have apparent deviancies or medically diagnosed handicaps at full-term gestational age. Thus, clues to disruption must come from the intensive observations that are made in the study.

Because of the very intensive nature of the observations for assessment in our project, the procedures are not considered in the category of an assessment "tool," although assessment is a primary objective. We have already identified some patterns that place infants at risk (Thoman, Miano and Freese, 1977; Thoman, 1978) from studies of normal infants, and our expectation

is that the inclusion of risk infants in our studies will provide the opportunity to explore a larger number of patterns that may potentially place an infant or a relationship at risk.

In conclusion, we believe that the intensive study of individuality among infants will increase our understanding of development -- a process which can only occur in individuals rather than groups, a process which reflects the interactive effects of experience and endogenous changes. A focus on developing individuals can potentially provide a common ground for those concerned with "basic research" and those concerned with clinical assessment and intervention. A coalition of these interests, expressed in an emphasis on assessment and prediction for the individual infant, should lead to research providing a greater understanding of normal developmental processes and of developmental dysfunction, as well as information on the complexity of measurement that may be necessary for identifying difficulties along the developmental course.

Footnote

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Footnotes

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Table 1

Mother and Infant Behaviors, Birth to Five Weeks

Mother's Location
- Out
- Far
- Near
- In contact
- Holding infant
- Carrying infant
- Holding infant at shoulder

Infant's Location
- Crib
- Cradle Board
- Other -

Infant's position
- Prone
- Supine
- Upright

Mother-Infant activity
- Changing infant
- Feeding infant
- Bathing infant
- None of these

Feeding inputs
- Breast or bottle
- Water
- Solids

Maternal Stimulation
- Pacifier
- Suck-stimulation (during feeding)
- Positioning infant for en face (eyes are open)
- Looking at infant
- Talking to infant
- Smiling or laughing at infant
- Patting
- Caressing
- Moving
- Rocking
- Immersing baby (during bath)
- Mother detaches baby from nipple (during feeding)

Infant Behaviors
- Not attached to nipple (during feeding)
- Not sucking (during feeding)
- Vocalize (non-fussy)
- Smile
- Frown
- Grimace
- Burp
- Bowel movement
- Spit up
- Hiccup
- Gag
- Jitter
- Hand-mouth
- Suck hand or fingers
- Grunt
- Yawn
- Sneeze
- Cough
- No body movements
- Small body movements
- Large body movements

Infant States
- Sleep
  - Active
  - Quiet
- Wake
  - Drowse
  - Daze
  - Alert
  - Waking active
  - Brief fuss
  - Sustained fussing
  - Crying
- Indefinite
- Eyes Closed (when mother holding infant ar sleep state cannot be judged).

Sleep Behaviors
- Rapid eye movements (REMs: brief, sustained, REM-storm)
- Eyes open (briefly, as during REM)
- Mouthing
- Rhythmic mouthing
- Sucking
- Jerk
- Startle
- Sigh
- Sigh-sob
- Occurrence of any infant behavior listed above

Table 2

Mean percent (of base variable) over weeks 2, 3, 4, and 5, for Pair M and the group of 20 mother-infant pairs; standard error of measurement; and lower bounds reliability coefficient.

		Pr.M	$\bar{X}_{20}$	SEM_{eas}	r_{tt}
Baby:	Behavioral States				
	Wake (Total)	38.6	34.5	4.8	.50
	Alert (Total)	19.2	14.5	2.6	.72
	Fuss or Cry (Total)	3.0	4.1	1.2	.73
	Drowse or Daze (Total)	15.3	13.3	2.4	.21[a]
	Episodes of Sleep 5 min	3.0	2.7	0.5	.39[a]
	Quiet Sleep (Sleep)	42.0	33.0	3.4	.70
	Quiet Sleep (Quiet Sleep)	89.9	87.0	5.5	.49
Mother and Baby:	Interacting Situations				
	Caretaking (Total)	11.9	14.3	2.3	.80
	Caretaking (Hold or Carry)	25.0	43.2	5.7	.82
	Hold or Carry (Total)	28.5	26.9	4.0	.84
	Social Interaction (Total)	13.7	10.4	2.4	.73
	Social Interaction (Baby Awake)	35.0	29.5	4.9	.80
Baby States During Interaction					
	Alert (Social Interaction)	31.8	44.0	7.3	.71
	Fuss or Cry (Social Interaction)	12.8	9.9	3.9	.76
	Drowse or Daze (Social Interaction)	53.8	40.4	6.4	.73
	Alert (Feed)	21.3	25.7	8.0	.75

Baby States During Interaction (Con't)	Pr.$\underline{N}$	$\bar{X}_{20}$	SEM_{eas}	r_{tt}
Drowse or Daze (Feed)	71.5	45.6	8.0	.65
Alert (Change or Bathe)	76.1	52.1	11.7	.60
Drowse or Daze (Change or Bathe)	3.3	6.0	3.7	.46
Fuss or Cry (Change or Bathe)	6.1	27.5	10.3	.62
Mother: Stimulation During Interaction				
Talking (Social Interaction)	43.0	46.1	6.2	.86
Stimulating (Social Interaction)	86.0	81.2	4.6	.74
Looking (Fuss or Cry)	70.6	60.9	9.2	.78
Talking (Fuss or Cry)	46.5	41.2	7.5	.84
Stimulating (Fuss or Cry)	58.8	35.4	7.8	.82
Mother: Affectionate Stimulation				
Caress (Total)	13.3	8.4	1.5	.83
Pat (Total)	8.0	3.5	1.0	.79
Mutual Visual Attention				
Vis-a-vis (Total)[b]	2.3	2.6	0.8	.59
Vis-a-vis (Mother Looking and Baby Awake)[b]	8.5	12.4	3.6	.71

[a] $p > .05$

[b] Significant increase over weeks, $p > .05$

Figure Captions

Fig. 1 Relational measures of mother and baby behaviors:

Percent of the total observation that the mother is holding the baby:

Hold (Total) = 27%

Percent of the total observation that the baby is alert: Alert (Total) = 15%

Percent of the total observation that the baby is alert while the

mother is holding him/her: Alert & Hold (Total) = 11%

Percent of the total observation that the baby is alert while the

mother is not holding him/her: Alert & Not Hold (Total) = 3%

Percent of the time when the mother is holding the baby that he/she

is alert: Alert (Hold) = 42%

Percent of the time when the mother is not holding the baby that he/she

is alert: Alert (Not Hold) = 13%

Fig. 2 Profile of behavioral states for Baby M, compared to the group on each measure.

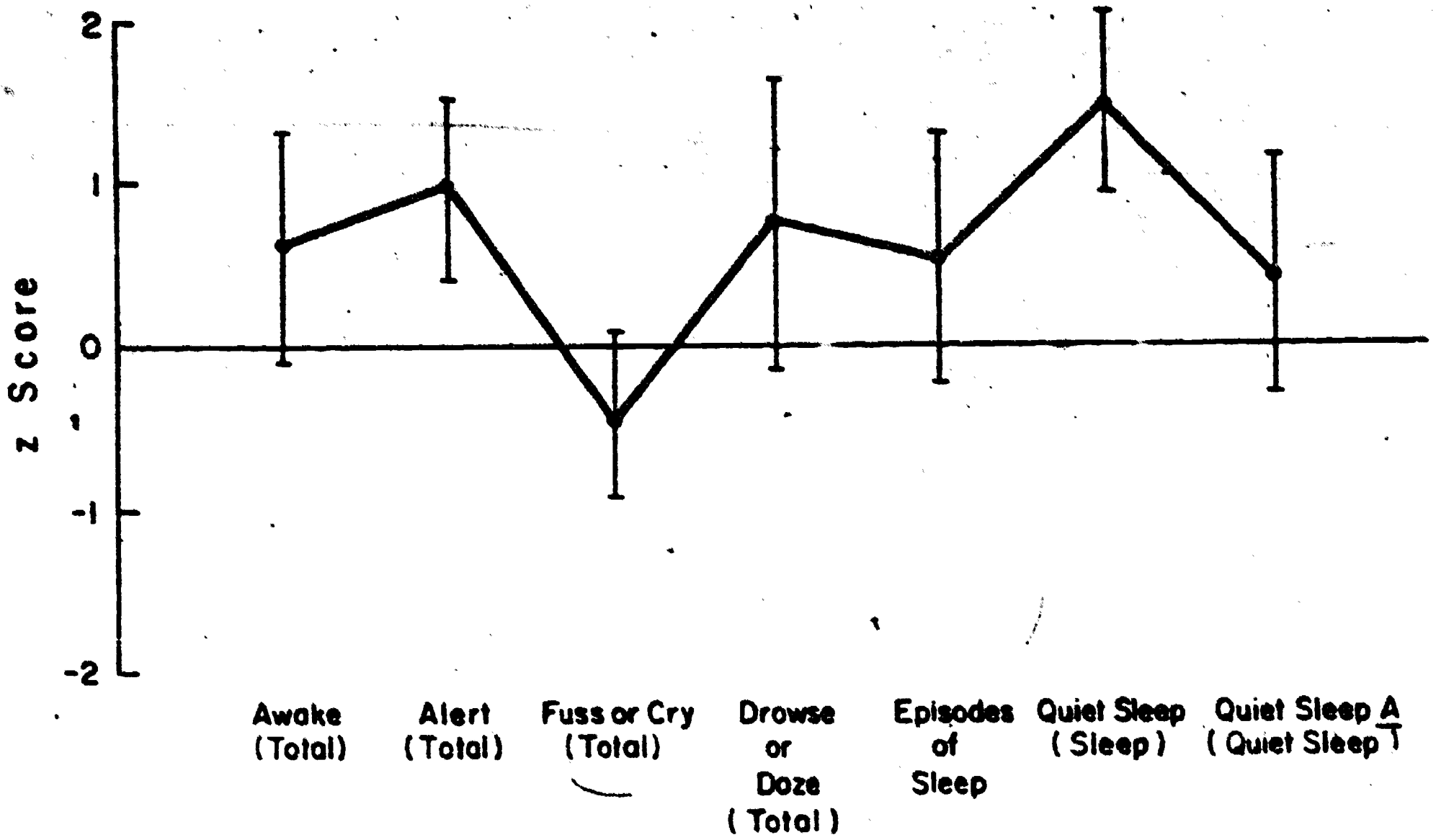
Fig. 3 Profile indicating maternal activities, compared to the group on each measure.

Fig. 4 Profile of Baby M's behavioral states during social interaction, feeding, and caretaking.

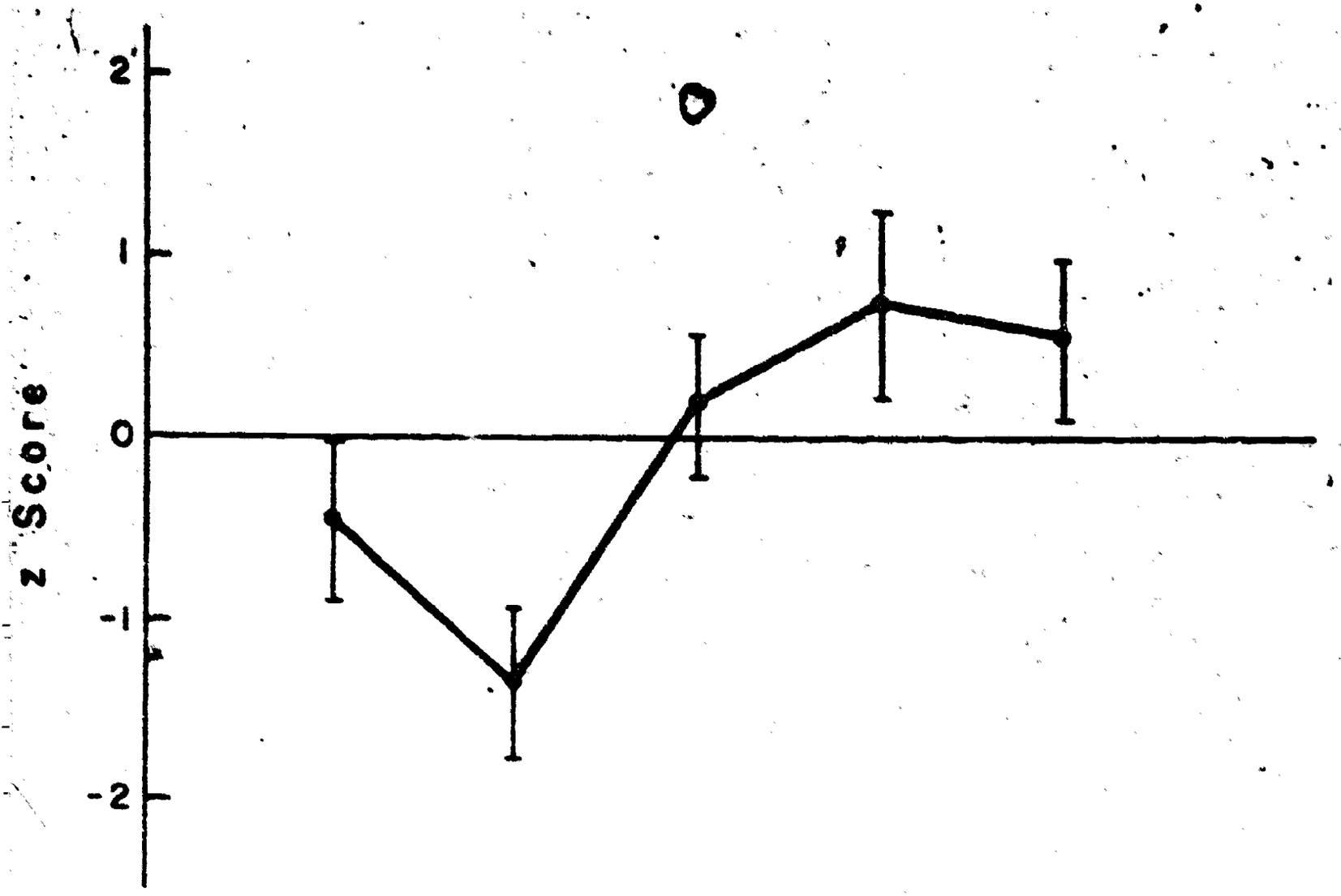
Fig. 5 Profile of Mother M's maternal attention variables during social (non-caretaking) interaction, and when Baby M was fussing or crying.

Fig. 6 Levels of caressing and patting by Mother M; and level of mutual visual looking and of unilateral visual attention by Mother M.

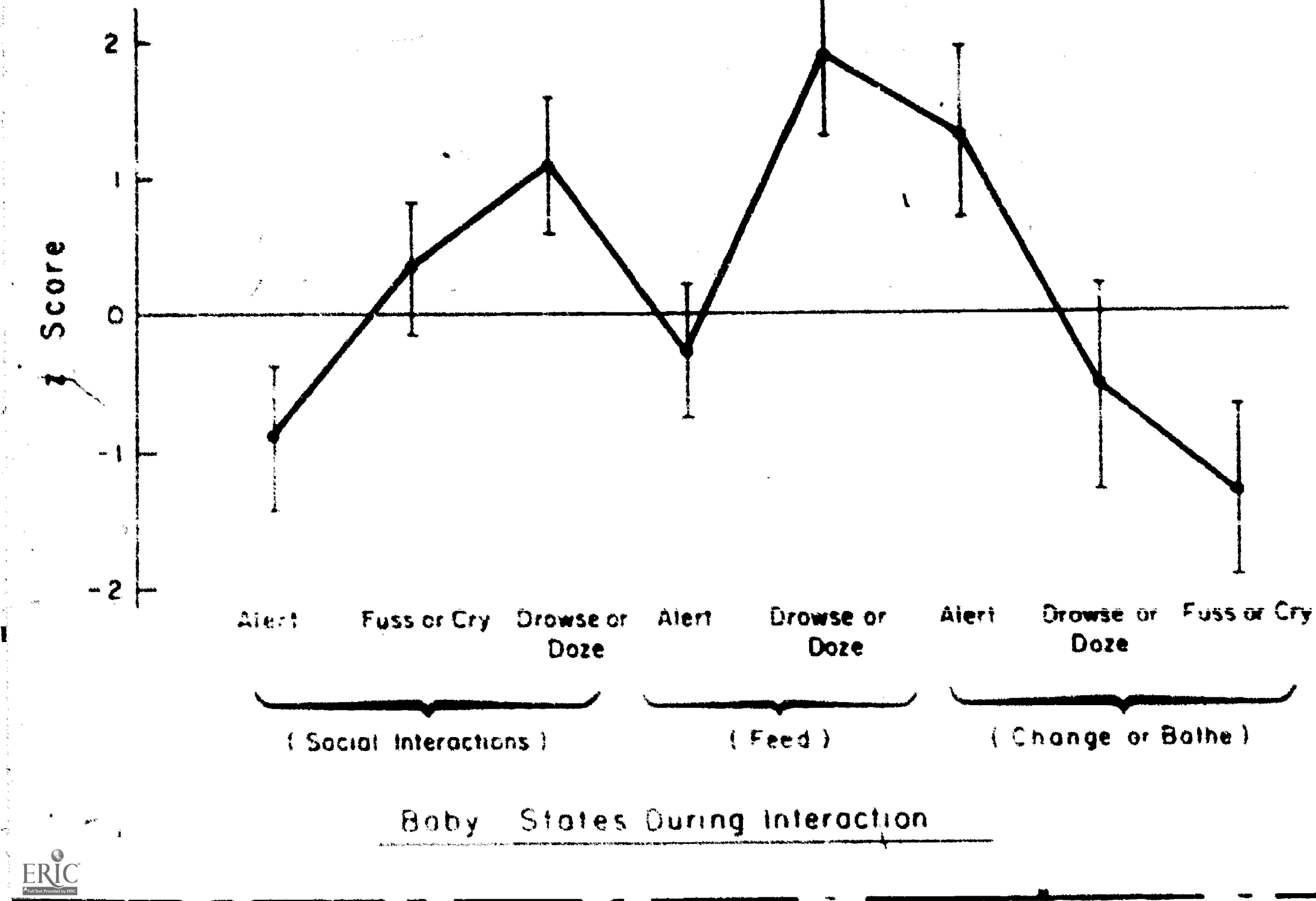
7- HOUR OBSERVATION
A.
MOTHER HOLD
MOTHER NOT HOLD
B.
BABY ALERT
BABY NOT ALERT
C.
B. ALERT
B. ALERT
B. NOT ALERT
B. NOT ALERT
MOTHER HOLD
MOTHER NOT HOLD



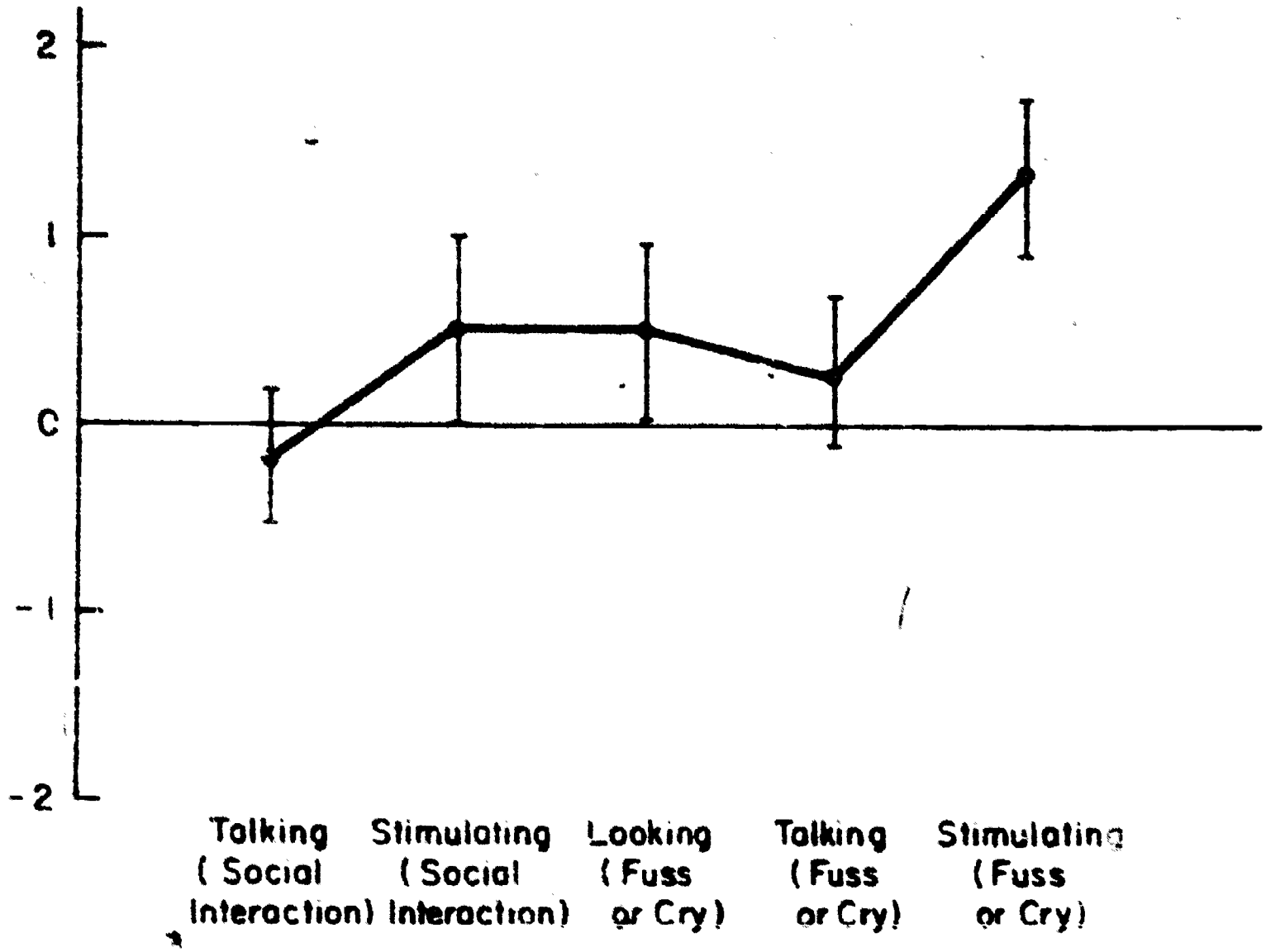
Baby : Behavioral States



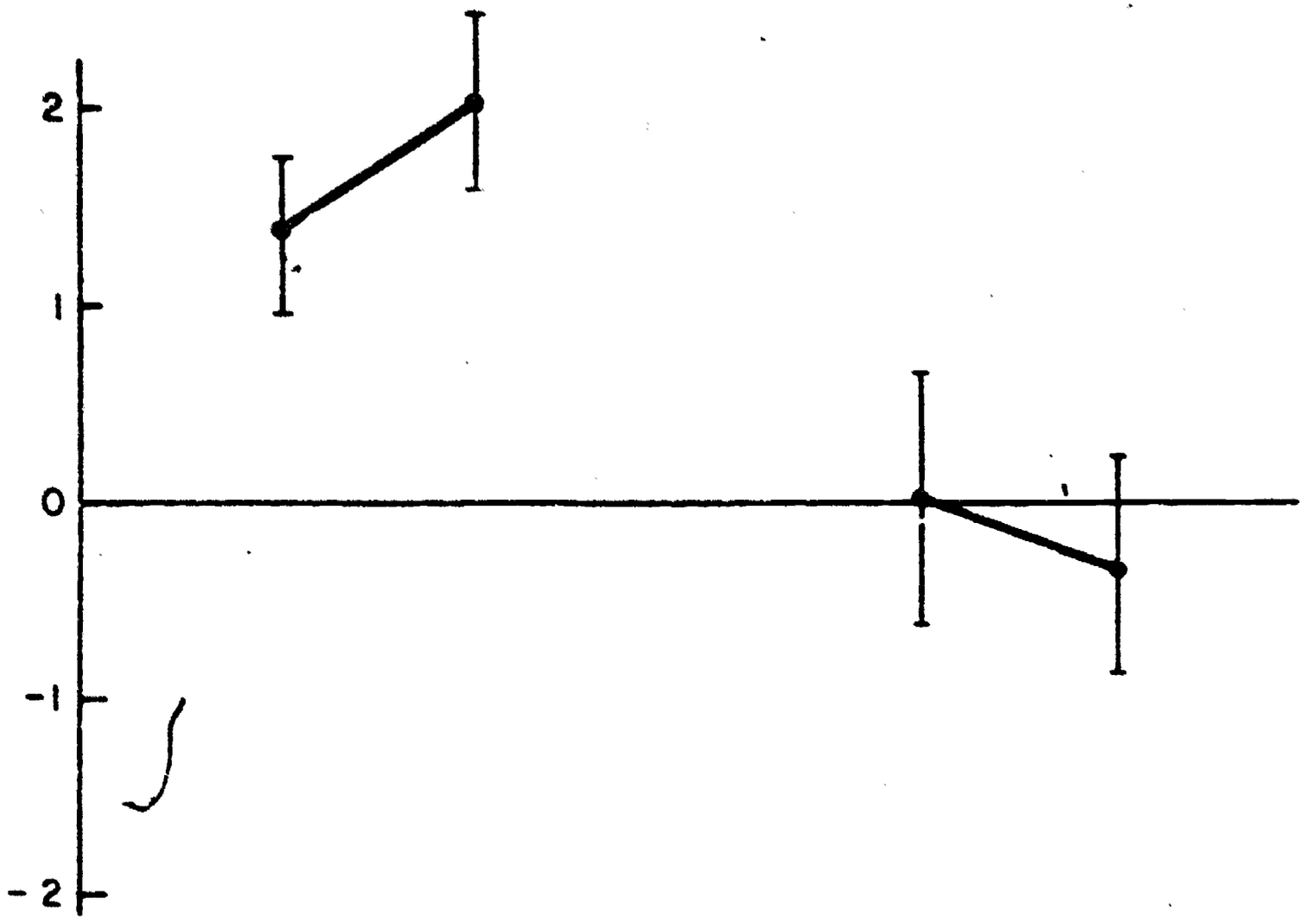
Mother & Baby : Interacting Situations



Baby States During Interaction



Mother : Stimulation During Interaction


2
1
0
-1
-2
z Score
Coress (Total)
Pat (Total)
Vis-a-Vis (Total)
Vis-a-Vis (Mother Looking & Baby Awake)
Mother Affectionate Stimulation
Mutual Visual Attention